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ABSTRACT

A rationale for the use of gaming and simulation for instructional purposes is developed in the introduction to this paper. The major portion of the text is comprised of several models of computer programs for economics instruction. (SHM)

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SAMPLE EXECUTIONS OF COMPUTER PROGRAMS FOR ECONOMICS INSTRUCTION

(APL - CAI)

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INTRODUCTION

Game Theory

The theory of games provides a means of describing the strategic behavior of one or more actors who have to make choices in conflict situations (games) in which the payoffs (potential outcomes) are a function of the choices made by all parties to the conflict. Game theory modeling is normative in that it prescribes the choice or combination of choices that lead to the best payoff under given circumstances. The theory postulates a rational actor who will always follow his best strategy. In other words, game theory is a set of mathematical tools for dealing with explicit types of conflict situations. (E.g., the minimax principle is derived from game theory.) Payoffs may be zero sum (one actor wins, the other loses), or non zero sum (both players win, or both may lose). Even two-person games may be quite complex. For example, the "Prisoner's Dilemma" may be solved via game theory.

> Two suspects are taken into custody and separated. The district attorney is certain that they have been partners in crime, but he does not have adequate evidence to convict them. He gives each prisoner two alternatives: to confess to the crime the police know he and his partner are guilty of, or deny it. If neither confesses, then the district attorney states that he will book them on a minor charge (such as illegal possession of a weapon), and they will receive minor punishment. If they both confess, they will be prosecuted, but with recommendation of leniency. If one confesses and the other does not, the confessor will be treated leniently for turning state's evidence, whereas the other will have "the book" thrown at him.
>
> PAYOFF (years in prison) MATRIX

		PERSON B	
		Not confess	Confess
PERSON A	Not confess	2, 2 neither confesses	10, 0 B only confesses
	Confess	0, 10 A only confesses	5, 5 both confess

Note that the rational strategy for the individual play (minimize expected prison sentence) would dictate a "confess" strategy. However, both parties pursuing this strategy will cause both to receive 5 year sentences. Cooperation in refusing to confess

would result in a 2-year sentence for both players.

Thus, even in a simple situation we have exhibited an inconsistency between individual and group or coalition decision-making (the fallacy of composition) which has important implications in both welfare economics and the theory of public goods.

But game theory, as a formal mathematical tool of behavioral research (perhaps best exemplified in the classic work by von Neuman and Morgenstern) has little to do with the practical aspects of gaming and simulation for instructional purposes.

Games and Simulations

A "simile" is a figure of speech directly denoting a resemblance in one or more aspects of one thing to another. A simulation is a special kind of model--and a model is a special way of expressing theory.

THEORY Attempts to describe the components of some aspect of reality and to specify the nature of the relationship among components. A theory which has become verified via evidence is called a law.

MODEL A model is a way of expressing a theory. Models may be expressed by physical objects (e.g., pipes carrying a liquid to represent the national income and product flows), or a mathematical expression (in symbolic or graphical form), or as a diagram indicating relationships, causality, or flows.

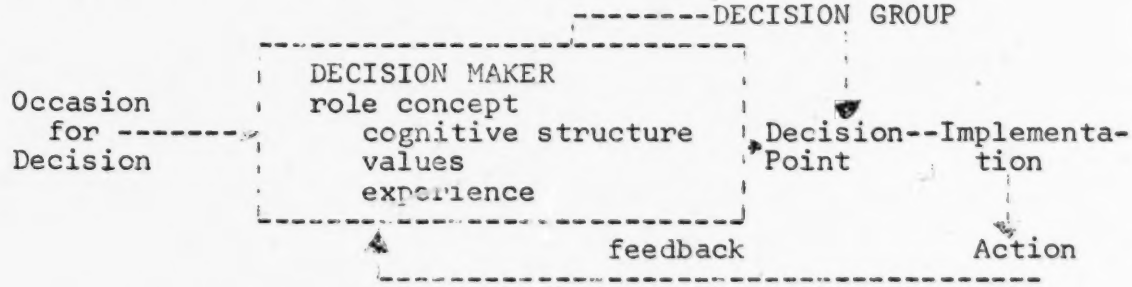
A simulation is an operating model of a referent system or subsystem which allows us to investigate the dynamic properties of the system via abstraction, simplification, and aggregation. Simulations of social systems are more primitive than simulations of physical systems. There is more randomness, unpredictability, and uncertainty when dealing with social systems due to their complexity.

What is the distinction between a "simulation" and a "game"? If we have two computers playing chess (the game of chess itself simulates medieval warfare), we have a simulated chess game. The

extent to which a simulation can be called a game depends wholly upon whether the operating model is deterministic or tentative, and the extent to which the model relies upon human participation as an intrinsic component of its operation.

gaming	simulation
-heavy human participation and manipulation	-self-contained and complete model
-competitive situation	-events determined within the system
-informal rules	-tightly structured
-weak theory and scanty data	-good theory and reliable data for all relevant variables

Gaming involves players intellectually and emotionally in a situation replicating some aspect of the real world. The players become goal oriented and may manipulate decision variables to achieve desired outcomes under laboratory conditions involving ambiguity or probabilistic situations. Players are free to explore the consequences of their actions and to learn (modify their behavior) as feedback from the model confronts their values, cognitive structure, and acquired experience.



The advantages of games and simulations in discovering reality may be summarized as follows:

1. They provide a laboratory midway between simplistic and fragmented models on one hand, and the bewildering real world on the other.

2. They provide replication and experimenter-controlled manipulation.
3. They permit time compression.
4. They may reduce the number of variables that must be considered.
5. They permit study of processes that cannot be studied directly in nature.
6. They are serendipity-prone because the gamer is experimenting in a rich environment and will therefore usually discover something he did not expect.

The game constitutes a kind of caricature of some aspect of social life. For children, games are an introduction to life. There is no reason why games cannot serve as an introduction to the world of economics.

Three postulates concerning education:

1. The mind is an instrument to be honed, rather than a bin to be filled.
2. If you make a horse thirsty, he will find the water for himself and drink deeply.
3. The future will not belong to those who are merely information storage and retrieval systems, but rather to those who understand a world of simultaneous determination and multiple causality and who have learned to learn.

In summary, gaming as a teaching technique allows for individualized variation in pace, scope, and depth of study for each student. Gaming heightens the interest and motivation of students by involving them in a learning experience. Gaming serves as a common, shared experience promoting comraderie, discussion, and a sense of discovery. Gaming provides an opportunity to apply and test knowledge or theories gleaned from other sources. Gaming, though participation, elicits in-

sight, empathy, and understanding of the world experienced by real decision-makers. Gaming and simulations provide a simplified world that is easier for the participant to comprehend than the whole of the referent systems being represented. Games and simulations are therefore vicarious experiences introducing us all, like the child at play, to life.

TO USE THE COMPUTER TERMINAL:

1) *PLUG IN THE TERMINAL AND ACOUSTIC COUPLING*

2) *TURN THE POWER 'ON' FOR BOTH THE COUPLING AND THE TERMINAL*

3) *BE SURE THE TERMINAL IS IN THE 'COM' MODE*

4) *DIAL THE UCR COMPUTER AT* 7874307

5) *LISTEN BRIEFLY TO THE VOICE OF THE COMPUTER*

6) *PLACE THE TELEPHONE HEADSET SECURELY INTO THE ACOUSTIC COUPLING*

7) *WAIT FOR THE 'CARRIER' LIGHT TO COME ON*

8) *USE THE LOG-IN PROCEDURE AS FOLLOWS:*

```
)450502
OPR:  APL IS NOW RUNNING UNTIL 5:00 P.M.
012) 16.44.23 03/15/72 THOMPSONRCC

   A P L \ 3 6 0

      )COPY 2 STP1 DSTAT
SAVED   8.29.07 03/03/72
     DSTAT 1 5 3 4 2 6 7 8 9 20 11 2 4.5
SAMPLE SIZE          13
MAXIMUM              20
MINIMUM              1
RANGE                19
MEAN                 6.346153846
VARIANCE             25.55769231
STANDARD DEVIATION   5.055461632
MEAN DEVIATION       3.579881657
MEDIAN               5
MODE                 2
      )OFF
012  16.46.30 03/15/72 THO
CONNECTED     0.02.07  TO DATE     1.15.52
CPU TIME      0.00.01  TO DATE     0.00.43
```

9) *NOW HANG UP THE TELEPHONE AND TURN OFF THE TERMINAL.*

F. THOMPSON 3-15-72

```
)450502
NUMBER NOT IN SYSTEM
      )450502:FAT
OPR:  APL IS NOW RUNNING UNTIL 6:00 P.M.
014) 14.24.27 05/17/72 THOMPSONRCC

   A P L \ 3 6 0

      )LOAD MACRO
SAVED  14.22.44 05/17/72



      )WIDTH 70
WAS 100
      )FNS
ARAGORN BALIN   BIFOR   BILBO   BOFOR   BOMBUR  BOROMIR DENETHOR
DMACRO  DWALIN  EOMER   FANGORN FARAMIR FILI    FRODO   GANDALF GIMLI
GLOIN   GO      GORBAG  INITIALIZE      KILI    LEGOLAS MERIADOC
MODEL   OIN     PEREGRIN        SAMWISE SARUMAN SAURON  SHAGRAT
SMEAGOL THEODEN THORIN
      DMACRO

   THIS IS A FAIRLY SOPHISTICATED MACROECONOMIC MODEL DESIGNED TO
ENABLE THE STUDENT TO LEARN SOME MACROECONOMIC PRINCIPLES TO ACHIEVE
POLICY GOALS.  THESE GOALS GENERALLY ARE 1) FULL EMPLOYMENT, 2) PRICE
STABILITY, AND 3) ECONOMIC GROWTH.  THE POLICY VARIABLES ARE 1) THE
CHANGE IN GOVERNMENT SPENDING, 2) THE CHANGE IN THE MARGINAL TAX RATE,
AND 3) THE CHANGE IN THE MONEY SUPPLY.  THE GOAL FUNCTION IS SPECIFIED
IN SUCH A WAY AS TO MEASURE THE STUDENTS RELATIVE SUCCESS IN ACHIEVING
THE GOALS SPECIFIED WITH THE POLICY VARIABLES AT HIS DISPOSAL.

   (ALL DATA IN THIS MODEL IN CONSTANT PERIOD 0 DOLLARS UNLESS OTHERWI
      SE NOTED.)
VARIABLES:
 Y=NET NATIONAL PRODUCT
 C=CONSUMPTION EXPENDITURE
 I=NET INVESTMENT
 G=GOVERNMENT EXPENDITURE
 T=TOTAL TAXES
 D=DISPOSABLE INCOME
 E=RETAINED EARNINGS+CAPITAL CONSUMPTION ALLOWANCES
 M=MONEY SUPPLY (CURRENT DOLLARS)
 R=INTEREST RATE
 U=UNEMPLOYMENT RATE
 P2=RATE OF INFLATION
 Y2=RATE OF CHANGE IN NNP
 P=PRICE LEVEL (DECIMAL FORM)
 Q=POTENTIAL NNP
 A=INVENTORY DISINVESTMENT
 T0=INTERCEPT OF TAX FUNCTION
 T1=MARGINAL TAX RATE
 W=WELFARE OR GOAL FUNCTION

TO INITIATE THE PROGRAM, SIMPLY TYPE IN THE CODE NAME GIVEN TO YOU
BY YOUR INSTRUCTOR.  THE PROGRAM WILL HENCEFORTH SAVE YOUR RESULTS
FOR YOU AS YOU SIGN ON OVER A PERIOD OF TIME.
```

```
                          )450502:FAT
OPR:  APL IS NOW RUNNING UNTIL 6:00 P.M.
014) 13.59.51 05/17/72 THOMPSONRCC

   A P L \ 3 6 0

      )LOAD MACRO
SAVED  15.05.29 05/05/72
      SHAGRAT


 QUARTER 0 DECISION FOR PLAYER  STUDENT 030

GNP ACCOUNTS, QUARTER 0
Y 528.432  C 322.329  I 108.102  G 98  T 113.245
D 335.922  E 79.2647  M 131.6  R 4.16365  U 3.97805
P2 2.32349  Y2 7.88308  P 1.0101  Q 553.209  A 0
TO ¯40  T1 0.29  W 500

 TYPE IN THE POLICY DECISION VALUES FOR CHANGES IN M, G, T1.
 WHEN THE TYPEWRITER PAUSES ENTER NUMERICAL DATA IN THE ORDER
 INDICATED, SEPARATING EACH ITEM BY AT LEAST ONE BLANK.  TYPE
 A ZERO FOR NO CHANGE.  A NEGATIVE ENTRY IS PRECEDED BY
 THE NEGATION SIGN, E.G., ¯5 0 ¯.01
 WHICH MEANS:  REDUCE M BY 5, LEAVE G UNCHANGED, REDUCE T1 BY .01

 TO SAVE TERMINAL TIME, THE PROGRAM WILL HENCEFORTH BE RECYCLED
 TO AVOID THIS OPENING STATEMENT.  YOU WILL BE ASKED TO ENTER
 THE THREE DECISION VALUES AGAIN FOR THE NEXT QUARTER.

 READY FOR YOUR FIRST DECISION TODAY?  HERE GOES.  ENTER M, G, T1

⎕:
      1.5  2.5  ¯0.01



GNP ACCOUNTS, QUARTER 1
Y 542.053  C 334.073  I 107.48  G 100.5  T 111.775
D 348.97  E 81.308  M 133.1  R 4.36768  U 3.44396
P2 2.32349  Y2 10.311  P 1.0101  Q 558.015  A 0
TO ¯40  T1 0.28  W 512.397

 DO YOU WISH TO RENDER ANOTHER POLICY DECISION?
 TYPE: 1 FOR YES; 0 FOR NO
⎕:
      1
PLEASE ENTER THREE VALUES FOR M, G, T1 AGAIN
⎕:
      10  15  ¯.01
```

```
THE COMPUTER HAS DETECTED AN INFLATIONARY GAP = 31.2794  YOU WILL NOTICE
THE EFFECTS OF YOUR SPENDTHRIFT POLICIES NEXT QUARTER.



GNP ACCOUNTS, QUARTER 2
Y 562.817  C 349.791  I 97.5267  G 115.5  T 111.961
D 366.434  E 84.4226  M 143.1  R 4.71493  U 2.5
P2 3.4668  Y2 15.3227  P 1.01886  Q 562.817  A 9.5402
TO -40  T1 0.27  W 528.473

 DO YOU WISH TO RENDER ANOTHER POLICY DECISION?
 TYPE: 1 FOR YES; 0 FOR NO
?:
      1
PLEASE ENTER THREE VALUES FOR M, G, T1 AGAIN
?:
      -10  -10  .10
YOU HAVE GENERATED A DEFLATIONARY GAP = 78.0294  CAREFUL, OR YOU JOIN THE
RANKS OF THE UNEMPLOYED TOO.



GNP ACCOUNTS, QUARTER 3
Y 489.383  C 267.413  I 116.469  G 105.5  T 141.072
D 274.904  E 73.4074  M 133.1  R 3.59156  U 7.03809
P2 12.7932  Y2 -52.1908  P 1.05144  Q 567.412  A 0
TO -40  T1 0.37  W 402.328

 DO YOU WISH TO RENDER ANOTHER POLICY DECISION?
 TYPE: 1 FOR YES; 0 FOR NO
?:
      1
PLEASE ENTER THREE VALUES FOR M, G, T1 AGAIN
?:
      5  5  -.05



GNP ACCOUNTS, QUARTER 4
Y 526.527  C 307.153  I 108.874  G 110.5  T 128.489
D 319.059  E 78.979  M 138.1  R 3.94329  U 5.14648
P2 -0.43518  Y2 30.3599  P 1.0503  Q 572.434  A 0
TO -40  T1 0.32  W 451.09

 DO YOU WISH TO RENDER ANOTHER POLICY DECISION?
 TYPE: 1 FOR YES; 0 FOR NO
?:
      1
PLEASE ENTER THREE VALUES FOR M, G, T1 AGAIN
?:
```

```
      0  0  -0.05


GNP ACCOUNTS, QUARTER 5
Y 566.267  C 351.592  I 104.176  G 110.5  T 112.892
D 368.435  E 84.9401  M 138.1  R 4.78626  U 3.13067
P2 0.552946  Y2 30.1907  P 1.05175  Q 577.3  A 0
TO -40  T1 0.27  W 503.625

 DO YOU WISH TO RENDER ANOTHER POLICY DECISION?
 TYPE: 1 FOR YES; 0 FOR NO
□:
      0
  END OF SESSION.  SEE YOU NEXT TIME.
 SAVE YOUR RESULTS FOR YOUR NEXT DECISION.
   BE SURE TO SIGN OFF LIKE THIS:
)SAVE MACRO
)OFF



      )SAVE MACRO
  14.22.44 05/17/72
      )OFF
014  14.22.52 05/17/72 THO
CONNECTED     0.23.01  TO DATE    23.22.49
CPU TIME      0.00.07  TO DATE     0.10.27
```

```
      )LOAD MACRODRILL
SAVED  15.53.43 03/15/72

)WIDTH 70
WAS 110
      )FNS
DFT     DMAC    DUMP    ERROR   ERRORS  MACL1   MACO3   MACS3   MODEL1
MODEL2  MODEL3  MODEL4  TESTIT  TIMECALL        TIMEUP
      DMAC

   MACO3 HAS FOUR LEVELS OF COMPLEXITY.  LEVEL 1 SHOWS THE PERIOD
BY PERIOD MOVEMENT OF AN ECONOMY TOWARDS EQUILIBRIUM WHEN THE RATE OF
INVESTMENT OR SAVINGS IS CHANGED.  LEVEL 2 INTRODUCES GOVERNMENT
INTO THE MODEL AND DOES COMPUTATIONAL WORK FOR PROBLEMS SUPPLIED BY
THE PROGRAM.  TOTAL TAX RECEIPTS, GOVERNMENT EXPENDITURE AND THE
INVESTMENT RATE ARE THE POLICY VARIABLES.  LEVEL 3 INTRODUCES THE
CONCEPT OF THE MARGINAL TAX RATE (TAX RECEIPTS ARE A LINEAR FUNCTION
OF GNP).  THE MARGINAL TAX RATE IS A POLICY VARIABLE ALONG WITH
GOVERNMENT EXPENDITURE AND THE RATE OF INVESTMENT.  LEVEL 4 IS A
TWO COUNTRY MODEL WITH THE FUNCTIONS OF LEVEL 3 PLUS NET EXPORTS
AS A POLICY VARIABLE.  IN ALL LEVELS THE STUDENT IS ASKED TO FIND THE
MARGINAL PROPENSITY TO CONSUME AND THE INTERCEPT OF THE CONSUMPTION
FUNCTION, AND IN LEVELS 3 AND 4 THE FIRST MARGINAL TAX RATE.  IN
LEVEL 4 THE MARGINAL PROPENSITY TO IMPORT MUST ALSO BE FOUND.  SINCE
THE BASIC EQUATIONS ARE GIVEN TO THE STUDENT, HE SHOULD BE ABLE TO
CALCULATE THESE VALUES.  IN LEVELS 2, 3, AND 4, THE PROBLEMS ARE
SUPPLIED AND THE COMPUTER CAN DO THE ARITHMETIC.  ADDITIONAL PROBLEMS
CAN BE DEVISED BY THE INSTRUCTOR.

IF YOU WISH THE IMPLICT FORMS OF THE EQUATIONS USED IN LEVELS 1, 2,
 3, AND 4, TYPE:  )COPY 515 WS1 MODEL    AND THEN  MODEL1,
 MODEL2, MODEL3, MODEL4.

TO INITIATE MACO3 TYPE:  MACO3

      MODEL1
MODEL 1

ENDOGENOUS VARIABLES:  Y, C, S
EXOGENOUS VARIABLES:  I
PARAMETERS:  α, MPC
CONSUMPTION FUNCTION:  C=α+MPC×Y
AGGREGATE DEMAND:  Y=C+I
AGGREGATE SUPPLY:  Y=C+S
EQUILIBRIUM CONDITION:  AS=AD

Y=C+I=α+MPC×Y+I      MULTIPLIER=1÷(1-MPC)      I.E., ΔY=ΔI÷(MPS)
```

```
      MODEL2
   MODEL 2

ENDOGENOUS VARIABLES:  Y, C, S, DY
EXOGENOUS VARIABLES:  I, G, T
PARAMETERS:  α, MPC
CONSUMPTION FUNCTION:  C=α+MPC×DY
INCOME AFTER TAXES:  DY=Y-T
AGGREGATE DEMAND:  Y=C+I+G
AGGREGATE SUPPLY:  Y=C+S+T
EQUILIBRIUM CONDITION:  AS=AD

Y=C+I+G=α+MPC(Y-T)+I+G

MULTIPLIERS:  THE CHANGE IN Y IN RESPONSE TO CHANGES IN I, G, T
E.G.,  ΔY=ΔG×MULTIPLIER  [WHICH IS 1÷(1-MPC)  FOR I, G, AND -MPC÷(1-MP
      C)  FOR T]

      MODEL3
   MODEL 3

ENDOGENOUS VARIABLES:  Y, C, S, T, DY
EXOGENOUS VARIABLES: I, G
PARAMETERS:  α, MPC, MTR
CONSUMPTION FUNCTION:  C=α+MPC×DY
INCOME AFTER TAXES:  DY=Y-T
TAX FUNCTION:  T=MTR×Y
AGGREGATE DEMAND:  Y=C+I+G
AGGREGATE SUPPLY:  Y=C+S+T
EQUILIBRIUM CONDITION:  AS=AD

Y=C+I+G=α+MPC(Y-MTR×Y)+I+G  WHERE THE MULTIPLIER=1÷(1-MPC+MPC×MTR)

      MODEL4
   MODEL 4

ENDOGENOUS VARIABLES:  Y, C, S, T, IM, DY
EXOGENOUS VARIABLES:  I, G, EX
PARAMETERS:  α, MPC, MTR, MPI
CONSUMPTION FUNCTION:  C=α+MPC×DY
INCOME AFTER TAXES:  DY=Y-T
TAX FUNCTION:  T=MTR×Y
IMPORT FUNCTION:  IM=MPI×Y
AGGREGATE DEMAND:  Y=C+I+G+(EX-IM)
AGGREGATE SUPPLY:  Y=C+S+T
EQUILIBRIUM CONDITION:  AS=AD

Y=C+I+G+(EX-IM)=(α+I+G+EX)÷(1-MPC+MPC×MTR+MPI)
MULTIPLIER=1÷(MPS+MTR+MPI-MPS×MTR)
```

```
      MACO3


HI!  THIS IS MACROECONOMIC PROGRAM  ***MACO3***.
TYPE IN A 1, 2, 3, OR 4 FOR THE LEVEL OF DIFFICULTY THAT YOU WISH TO A
      TTEMPT.
DIFFICULTY RANKING:  1<2<3<4.
□:
      1

    THIS IS A SIMPLE KEYNESIAN MACROECONOMIC MODEL WITHOUT GOVERNMENT.
YOUR FIRST TASK IS TO FIND THE MPC AND THE INTERCEPT OF THE CONSUMPTIO
      N FUNCTION.


THE VARIABLES USED IN THIS MODEL ARE:

GNP=GROSS NATIONAL PRODUCT.
  C=TOTAL CONSUMPTION.
  S=TOTAL SAVINGS.
  I=NET PRIVATE DOMESTIC INVESTMENT.

HERE ARE THE  (EQUILIBRIUM) VALUES FOR TWO YEARS.

YEAR= 1  GNP= 650  C= 615  S= 35  I= 35

YEAR= 2  GNP= 680  C= 642  S= 38  I= 38

WHAT IS THE MPC?   MPC=ΔC÷ΔGNP
□:
      (642-615)÷(680-650)
RIGHT!  THE MPC IS 0.9
WHAT IS THE INTERCEPT OF THE CONSUMPTION FUNCTION?  INTERCEPT=C-(MPC×G
      NP)
□:
      20
*** THE INTERCEPT YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
□:
      30
VERY GOOD. YOU ARE CORRECT. THE INTERCEPT IS 30
DO YOU WANT TO GO ON TO THE SECOND PART OF THIS LEVEL? TYPE YES OR NO.
YES

THIS IS THE SECOND PART OF LEVEL ONE.  YOU WILL BE GIVEN AN EQUILIBRIU
      M
LEVEL OF GNP AND WITH THE AID OF THE ABOVE INFORMATION YOU ARE TO RAIS
      E
OR LOWER THE GNP TO THE STATED LEVEL BY RAISING OR LOWERING ONLY THE R
      ATE
OF NET PRIVATE DOMESTIC INVESTMENT.

DO YOU KNOW HOW TO CALCULATE THE MULTIPLIER?
NO
THE MULTIPLIER IN THIS MODEL IS DEFINED AS: 1÷(1-MPC), ΔGNP=MULTIPLIER
      ×ΔI
THE EQUILIBRIUM LEVEL OF GNP IS NOW 680 WITH C I AND S AS ABOVE.
RAISE GNP TO  714
TYPE IN THE RATE OF INVESTMENT
□:
```

41.4

PERIOD	GNP	C	I	S	AGG DMND	AGG SPLY	AD-AS
1	683.40	642.00	41.40	38.00	683.40	680.00	3.40
2	686.46	645.06	41.40	38.34	686.46	683.40	3.06
3	689.21	647.81	41.40	38.65	689.21	686.46	2.75
4	691.69	650.29	41.40	38.92	691.69	689.21	2.48
5	693.92	652.52	41.40	39.17	693.92	691.69	2.23
6	695.93	654.53	41.40	39.39	695.93	693.92	2.01
7	697.74	656.34	41.40	39.59	697.74	695.93	1.81
8	699.36	657.96	41.40	39.77	699.36	697.74	1.63
9	700.83	659.43	41.40	39.94	700.83	699.36	1.46
10	702.14	660.74	41.40	40.08	702.14	700.83	1.32
.							
.							
.							
35	713.15	671.75	41.40	41.31	713.15	713.05	0.09

TASK ACCOMPLISHED!

THE EQUILIBRIUM LEVEL IS NOW 713.149
LOWER GNP TO 570.519
TYPE IN THE RATE OF INVESTMENT
□:

31.3

PERIOD	GNP	C	I	S	AGG DMND	AGG SPLY	AD-AS
1	703.13	671.83	31.30	41.31	703.13	713.15	-10.01
2	694.12	662.82	31.30	40.31	694.12	703.13	-9.01
3	686.01	654.71	31.30	39.41	686.01	694.12	-8.11
4	678.71	647.41	31.30	38.60	678.71	686.01	-7.30
5	672.14	640.84	31.30	37.87	672.14	678.71	-6.57
6	666.22	634.92	31.30	37.21	666.22	672.14	-5.91
7	660.90	629.60	31.30	36.62	660.90	666.22	-5.32
8	656.11	624.81	31.30	36.09	656.11	660.90	-4.79
9	651.80	620.50	31.30	35.61	651.80	656.11	-4.31
10	647.92	616.62	31.30	35.18	647.92	651.80	-3.88
.							
.							
.							
45	613.87	582.57	31.30	31.40	613.87	613.97	-0.10

YOU HAVE EXCEEDED YOUR GOAL BY 43.35

THE EQUILIBRIUM LEVEL IS NOW 613.874
RAISE GNP TO 736.649
TYPE IN THE RATE OF INVESTMENT
□:

43.5

PERIOD	GNP	C	I	S	AGG DMND	AGG SPLY	AD-AS
1	625.99	582.49	43.50	31.39	625.99	613.87	12.11
2	636.89	593.39	43.50	32.60	636.89	625.99	10.90
3	646.70	603.20	43.50	33.69	646.70	636.89	9.81
4	655.53	612.03	43.50	34.67	655.53	646.70	8.83
5	663.48	619.98	43.50	35.55	663.48	655.53	7.95
6	670.63	627.13	43.50	36.35	670.63	663.48	7.15
7	677.07	633.57	43.50	37.06	677.07	670.63	6.44
8	682.86	639.36	43.50	37.71	682.86	677.07	5.79
9	688.07	644.57	43.50	38.29	688.07	682.86	5.21
10	692.77	649.27	43.50	38.81	692.77	688.07	4.69
.							
.							
.							

```
MACO3


HI!  THIS IS MACROECONOMIC PROGRAM  ***MACO3***.
TYPE IN A 1, 2, 3, OR 4 FOR THE LEVEL OF DIFFICULTY THAT YOU WISH TO A
      TTEMPT.
DIFFICULTY RANKING:  1<2<3<4.
□:
      2
    THIS IS A KEYNESIAN MACROECONOMIC MODEL. NO WORLD TRADE.
INVESTMENT, GOVERNMENT EXPENDITURE AND TOTAL TAX RECEIPTS ARE POLICY V
      ARIABLES.
YOUR FIRST TASK IS TO FIND THE MPC AND THE INTERCEPT OF THE CONSUMPTIO
      N FUNCTION.


THE VARIABLES USED IN THIS MODEL ARE:

GNP=GROSS NATIONAL PRODUCT.
  C=TOTAL CONSUMPTION.
  S=TOTAL SAVINGS.
  I=NET PRIVATE DOMESTIC INVESTMENT.
 DY=DISPOSABLE INCOME.
  G=GOVERNMENT EXPENDITURE.
  T=TOTAL TAX RECEIPTS.

HERE ARE THE  (EQUILIBRIUM) VALUES FOR TWO YEARS.

YEAR= 1  GNP= 380  T= 15  DY= 365  C= 239  S= 126  I= 101  G=
      40

YEAR= 2  GNP= 377.75  T= 14  DY= 363.75  C= 238.25  S= 125.5  I=
      103.5  G= 36

WHAT IS THE MPC?   MPC=ΔC÷ΔDY
□:
      (239-238.25)÷(365-363.75)
RIGHT!  THE MPC IS 0.6
WHAT IS THE INTERCEPT OF THE CONSUMPTION FUNCTION?  INTERCEPT=C-(MPC×D
      Y)
□:
      30
*** THE INTERCEPT YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
□:
      25
*** THE INTERCEPT YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
□:
      20
VERY GOOD. YOU ARE CORRECT. THE INTERCEPT IS 20
DO YOU WANT TO GO ON TO THE SECOND PART OF THIS LEVEL? TYPE YES OR NO.
YES
LET'S TRY SOME PROBLEMS.

PROBLEM NUMBER 1
THE GNP IS NOW 377.75
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      105.5
TYPE IN THE TOTAL TAX RECEIPTS FOR NEXT YEAR.
□:
```

```
      14
TYPE IN GOVERNMENT EXPENDITURES FOR NEXT YEAR.
□:
      36
YEAR= 3  GNP= 382.75  T= 14  DY= 368.75  C= 241.25  S= 127.5  I=
      105.5  G= 36

PROBLEM NUMBER 2
THE GNP IS NOW 382.75
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      105.5
TYPE IN THE TOTAL TAX RECEIPTS FOR NEXT YEAR.
□:
      15
TYPE IN GOVERNMENT EXPENDITURES FOR NEXT YEAR.
□:
      36
YEAR= 4  GNP= 381.25  T= 15  DY= 366.25  C= 239.75  S= 126.5  I=
      105.5  G= 36

PROBLEM NUMBER 3
THE GNP IS NOW 381.25
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      105.5
TYPE IN THE TOTAL TAX RECEIPTS FOR NEXT YEAR.
□:
      15
TYPE IN GOVERNMENT EXPENDITURES FOR NEXT YEAR.
□:
      15
YEAR= 5  GNP= 328.75  T= 15  DY= 313.75  C= 208.25  S= 105.5  I=
      105.5  G= 15

PROBLEM NUMBER 4
THE GNP IS NOW 328.75
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      100
TYPE IN THE TOTAL TAX RECEIPTS FOR NEXT YEAR.
□:
      50
TYPE IN GOVERNMENT EXPENDITURES FOR NEXT YEAR.
□:
      50
YEAR= 6  GNP= 350  T= 50  DY= 300  C= 200  S= 100  I= 100  G=
      50

THE END HAS COME FOR ***MACO3***     LEVEL  2
```

```
      MACO3


HI!  THIS IS MACROECONOMIC PROGRAM  ***MACO3***.
TYPE IN A 1, 2, 3, OR 4 FOR THE LEVEL OF DIFFICULTY THAT YOU WISH TO A
      TTEMPT.
DIFFICULTY RANKING:  1<2<3<4.
□:
      3
    THIS IS A KEYNESIAN MACROECONOMIC MODEL. NO WORLD TRADE.
TAXES ARE A FUNCTION OF GNP. INVESTMENT, GOVERNMENT EXPENDITURE,
AND THE MARGINAL TAX RATE ARE POLICY VARIABLES.
YOUR FIRST TASK IS TO FIND THE MPC, THE INTERCEPT OF THE
CONSUMPTION FUNCTION, AND THE MARGINAL TAX RATE.


THE VARIABLES USED IN THIS MODEL ARE:

GNP=GROSS NATIONAL PRODUCT.
  C=TOTAL CONSUMPTION.
  S=TOTAL SAVINGS.
  I=NET PRIVATE DOMESTIC INVESTMENT.
 DY=DISPOSABLE INCOME.
  G=GOVERNMENT EXPENDITURE.
  T=TOTAL TAX RECEIPTS.

HERE ARE THE  (EQUILIBRIUM) VALUES FOR TWO YEARS.

YEAR= 1  GNP= 564.189  T= 67.7027  DY= 496.486  C= 417.189  S=
      79.2973  I= 107  G= 40

YEAR= 2  GNP= 567.568  T= 68.1081  DY= 499.459  C= 419.568  S=
      79.8919  I= 105  G= 43

WHAT IS THE MARGINAL TAX RATE?   MTR=ΔT÷ΔGNP
□:
      (68.1-67.7)÷(567.5-564.1)
YOUR ANSWER IS CORRECT. THE MTR IS 0.12
WHAT IS THE MPC?   MPC=ΔC÷ΔDY
□:
      (419.5-417.1)÷(567.5-564.1)
RIGHT!  THE MPC IS 0.8
WHAT IS THE INTERCEPT OF THE CONSUMPTION FUNCTION?  INTERCEPT=C-(MPC×D
      Y)
□:
      419.568-(0.8×499.459)
VERY GOOD. YOU ARE CORRECT. THE INTERCEPT IS 20
DO YOU WANT TO GO ON TO THE SECOND PART OF THIS LEVEL? TYPE YES OR NO.
YES
LET'S TRY SOME PROBLEMS.

PROBLEM NUMBER 1
THE GNP IS NOW 567.568
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      110
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
□:
```

```
      43
TYPE IN THE MARGINAL TAX RATE FOR THE NEXT YEAR.
□:
      0.12
YEAR= 3  GNP= 584.459  T= 70.1351  DY= 514.324  C= 431.459  S=
      82.8649  I= 110  G= 43

PROBLEM NUMBER 2
THE GNP IS NOW 584.459
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      110
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
□:
      43
TYPE IN THE MARGINAL TAX RATE FOR THE NEXT YEAR.
□:
      .15
YEAR= 4  GNP= 540.625  T= 81.0937  DY= 459.531  C= 387.625  S=
      71.9062  I= 110  G= 43

PROBLEM NUMBER 3
THE GNP IS NOW 540.625
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      110
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
□:
      43
TYPE IN THE MARGINAL TAX RATE FOR THE NEXT YEAR.
□:
      .10
YEAR= 5  GNP= 617.857  T= 61.7857  DY= 556.071  C= 464.857  S=
      91.2143  I= 110  G= 43

PROBLEM NUMBER 4
THE GNP IS NOW 617.857
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      110
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
□:
      50
TYPE IN THE MARGINAL TAX RATE FOR THE NEXT YEAR.
□:
      .10
YEAR= 6  GNP= 642.857  T= 64.2857  DY= 578.571  C= 482.857  S=
      95.7143  I= 110  G= 50

THE END HAS COME FOR ***MACO3***     LEVEL  3
```

```
      MACO3


HI!  THIS IS MACROECONOMIC PROGRAM  ***MACO3***.
TYPE IN A 1, 2, 3, OR 4 FOR THE LEVEL OF DIFFICULTY THAT YOU WISH TO A
      TTEMPT.
DIFFICULTY RANKING:  1<2<3<4.
?:
      4

    THIS IS A KEYNESIAN MACROECONOMIC MODEL WITH WORLD TRADE.
IMPORTS AND TAXES ARE A FUNCTION OF GNP.  INVESTMENT, GOVERNMENT
EXPENDITURES, THE MARGINAL TAX RATE, AND TOTAL EXPORTS ARE
THE POLICY VARIABLES. YOUR FIRST TASK IS TO FIND THE MPC, THE INTERCEP
      T OF THE
CONSUMPTION FUNCTION, THE MARGINAL TAX RATE, AND THE MPI.

THE VARIABLES USED IN THIS MODEL ARE:

GNP=GROSS NATIONAL PRODUCT.
  C=TOTAL CONSUMPTION.
  S=TOTAL SAVINGS.
  I=NET PRIVATE DOMESTIC INVESTMENT.
 DY=DISPOSABLE INCOME.
  G=GOVERNMENT EXPENDITURE.
  T=TOTAL TAX RECEIPTS.
 EX=TOTAL EXPORTS.
 IM=TOTAL IMPORTS.

HERE ARE THE  (EQUILIBRIUM) VALUES FOR TWO YEARS.

YEAR= 1  GNP= 421.488  C= 289.636  I= 94  G= 40  EX= 40
T= 50.5785  DY= 370.909  S= 81.2727  IM= 42.1488

YEAR= 2  GNP= 442.149  C= 302.364  I= 98  G= 43  EX= 43
T= 53.0579  DY= 389.091  S= 86.7273  IM= 44.2149

WHAT IS THE MARGINAL PROPENSITY TO IMPORT?    MPI=ΔIM÷ΔGNP
?:
      (44.2-42.1)÷(442.1-421.4)
CORRECT!  THE MPI IS 0.1
WHAT IS THE MARGINAL TAX RATE?   MTR=ΔT÷ΔGNP
?:
      .12
YOUR ANSWER IS CORRECT. THE MTR IS 0.12
WHAT IS THE MPC?   MPC=ΔC÷ΔDY
?:
      .9
*** THE MPC YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
?:
      .85
*** THE MPC YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
?:
      .89
→→→ SORRY. THE MPC IS  0.7
WHAT IS THE INTERCEPT OF THE CONSUMPTION FUNCTION?  INTERCEPT=C-(MPC×D
      Y)
?:
      43-(.7×389)
*** THE INTERCEPT YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
?:
```

```
      302-(.7×389)
*** THE INTERCEPT YOU HAVE ENTERED IS INCORRECT. PLEASE TRY AGAIN.
?:
      302-(.7×389)
→→→ TOO BAD. THE INTERCEPT OF THE CONSUMPTION FUNCTION IS
      30
DO YOU WANT TO GO ON TO THE SECOND PART OF THIS LEVEL? TYPE YES OR NO.
YES
LET'S TRY SOME PROBLEMS.

PROBLEM NUMBER 1
THE GNP IS NOW 442.149
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
?:
      100
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
?:
      43
TYPE IN EXPORTS FOR NEXT YEAR.
?:
      50
TYPE IN THE MARGINAL TAX RATE FOR NEXT YEAR.
?:
      .12
YEAR= 3  GNP= 460.744  C= 313.818  I= 100  G= 43  EX= 50
T= 55.2893  DY= 405.455  S= 91.6364  IM= 46.0744

PROBLEM NUMBER 2
THE GNP IS NOW 460.744
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
?:
      100
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
?:
      100
TYPE IN EXPORTS FOR NEXT YEAR.
?:
      50
TYPE IN THE MARGINAL TAX RATE FOR NEXT YEAR.
?:
      .12
YEAR= 4  GNP= 578.512  C= 386.364  I= 100  G= 100  EX= 50
T= 69.4215  DY= 509.091  S= 122.727  IM= 57.8512

PROBLEM NUMBER 3
THE GNP IS NOW 578.512
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
?:
      100
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
?:
      100
TYPE IN EXPORTS FOR NEXT YEAR.
?:
      50
TYPE IN THE MARGINAL TAX RATE FOR NEXT YEAR.
?:
      .20
```

```
YEAR= 5  GNP= 518.519  C= 320.37  I= 100  G= 100  EX= 50
T= 103.704  DY= 414.815  S= 94.4444  IM= 51.8519

PROBLEM NUMBER 4
THE GNP IS NOW 518.519
TYPE IN THE RATE OF INVESTMENT FOR NEXT YEAR.
□:
      110
TYPE IN GOVERNMENT EXPENDITURE FOR NEXT YEAR.
□:
      100
TYPE IN EXPORTS FOR NEXT YEAR.
□:
      50
TYPE IN THE MARGINAL TAX RATE FOR NEXT YEAR.
□:
      0.20
YEAR= 6  GNP= 537.037  C= 330.741  I= 110  G= 100  EX= 50
T= 107.407  DY= 429.63  S= 98.8889  IM= 53.7037

THE END HAS COME FOR ***MACO3***      LEVEL  4
```

```
      )LOAD SUMERIAN
SAVED  15.47.13 05/10/72
      )WIDTH 70
WAS 120
      SUMER


MY LORD AND MASTER, ABSOLUTE DICTATOR OF SUMER, I, YOUR HUMBLE (SNICKE
      R) SERVANT
 BEG TO REPORT ON THE STATE OF YOUR VAST DOMAIN.
 LAST YEAR, 0 PEOPLE DIED OF STARVATION,
 AND 5 NEW PEOPLE CAME INTO YOUR DOMAIN.

THE POPULATION OF YOUR DOMAIN IS NOW 95 LOYAL SUBJECTS.

YOU NOW OWN 1000 ACRES OF LAND.
WE PLANTED 1000 ACRES LAST YEAR. WE HARVESTED 3 BUSHELS PER ACRE.
 THE TOTAL HARVEST WAS THEREFORE 3000 BUSHELS.
 YOUR ENEMIES CAUSED RATS TO EAT (YUM) 200 BUSHELS.
 THEREFORE, YOU NOW HAVE 2800 BUSHELS IN YOUR STOREHOUSE.

MASTER, I AM READY TO EXECUTE YOUR COMMANDS FOR THE FOLLOWING YEAR.
 IF THOU ART READY TO ISSUE THEM, TYPE YES.  IF NOT, TYPE NO.
YES

MASTER, THIS YEAR WE CAN BUY OR SELL MORE LAND FOR 18 BUSHELS PER ACRE
      .
 HOW MANY ACRES DO YOU WISH TO BUY THIS YEAR?
[:
      0
 HOW MANY ACRES DO YOU WISH TO SELL?
[:
      10
HOW MANY BUSHELS OF GRAIN DO YOU WISH TO DISTRIBUTE AS FOOD?
[:
      1000
YOUR PEOPLE WILL STARVE!  DO YOU WISH THIS TO HAPPEN?
NO
 v
 O
HOW MANY BUSHELS OF GRAIN DO YOU WISH TO DISTRIBUTE AS FOOD?
[:
      2000
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
[:
      1000
COME NOW MASTER. THERE ARE ONLY 990 ACRES IN YOUR DOMAIN.
PRAY TELL ME AGAIN, MASTER;
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
[:
      990
THINK AGAIN, MASTER. YOU HAVE ONLY 980 BUSHELS LEFT IN YOUR STORE HOUS
      E.
THE GODS DECREE THAT 1 BUSHEL IS REQUIRED TO PLANT 1 ACRE.
PRAY TELL ME AGAIN, MASTER;
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
[:
```

```
      980

** A YEAR PASSETH...
 LAST YEAR, 0 PEOPLE DIED OF STARVATION,
 AND 1 NEW PEOPLE CAME INTO YOUR DOMAIN.

THE POPULATION OF YOUR DOMAIN IS NOW 96 LOYAL SUBJECTS.

YOU NOW OWN 990 ACRES OF LAND.
WE PLANTED 980 ACRES LAST YEAR. WE HARVESTED 3 BUSHELS PER ACRE.
 THE TOTAL HARVEST WAS THEREFORE 2940 BUSHELS.
 YOUR ENEMIES CAUSED RATS TO EAT (YUM) 98 BUSHELS.
 THEREFORE, YOU NOW HAVE 2842 BUSHELS IN YOUR STOREHOUSE.

MASTER, I AM READY TO EXECUTE YOUR COMMANDS FOR THE FOLLOWING YEAR.
 IF THOU ART READY TO ISSUE THEM, TYPE YES.  IF NOT, TYPE NO.
YES

MASTER, THIS YEAR WE CAN BUY OR SELL MORE LAND FOR 18 BUSHELS PER ACRE
.
 HOW MANY ACRES DO YOU WISH TO BUY THIS YEAR?
?:
      0
 HOW MANY ACRES DO YOU WISH TO SELL?
?:
      0
HOW MANY BUSHELS OF GRAIN DO YOU WISH TO DISTRIBUTE AS FOOD?
?:
      2000
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
?:
      842

** A YEAR PASSETH...
 LAST YEAR, 0 PEOPLE DIED OF STARVATION,
 AND 1 NEW PEOPLE CAME INTO YOUR DOMAIN.

THE POPULATION OF YOUR DOMAIN IS NOW 97 LOYAL SUBJECTS.

YOU NOW OWN 990 ACRES OF LAND.
WE PLANTED 842 ACRES LAST YEAR. WE HARVESTED 4 BUSHELS PER ACRE.
 THE TOTAL HARVEST WAS THEREFORE 3368 BUSHELS.
 YOUR ENEMIES CAUSED RATS TO EAT (YUM) 168.4 BUSHELS.
 THEREFORE, YOU NOW HAVE 3199.6 BUSHELS IN YOUR STOREHOUSE.

MASTER, I AM READY TO EXECUTE YOUR COMMANDS FOR THE FOLLOWING YEAR.
 IF THOU ART READY TO ISSUE THEM, TYPE YES.  IF NOT, TYPE NO.
YES

MASTER, THIS YEAR WE CAN BUY OR SELL MORE LAND FOR 15 BUSHELS PER ACRE
.
 HOW MANY ACRES DO YOU WISH TO BUY THIS YEAR?
?:
      10
HOW MANY BUSHELS OF GRAIN DO YOU WISH TO DISTRIBUTE AS FOOD?
?:
      22*97
```

```
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
□:
      1000
THINK AGAIN, MASTER. YOU HAVE ONLY 915.6 BUSHELS LEFT IN YOUR STORE HO
      USE.
THE GODS DECREE THAT 1 BUSHEL IS REQUIRED TO PLANT 1 ACRE.
PRAY TELL ME AGAIN, MASTER;
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
□:
      915.6

** A YEAR PASSETH...
 LAST YEAR, 1 PEOPLE DIED OF STARVATION,
 AND 2 NEW PEOPLE CAME INTO YOUR DOMAIN.

THE POPULATION OF YOUR DOMAIN IS NOW 98 LOYAL SUBJECTS.

YOU NOW OWN 1000 ACRES OF LAND.
WE PLANTED 915.6 ACRES LAST YEAR. WE HARVESTED 2 BUSHELS PER ACRE.
 THE TOTAL HARVEST WAS THEREFORE 1831.2 BUSHELS.
 YOUR ENEMIES CAUSED RATS TO EAT (YUM) 457.8 BUSHELS.
 THEREFORE, YOU NOW HAVE 1373.4 BUSHELS IN YOUR STOREHOUSE.

MASTER, I AM READY TO EXECUTE YOUR COMMANDS FOR THE FOLLOWING YEAR.
 IF THOU ART READY TO ISSUE THEM, TYPE YES.  IF NOT, TYPE NO.
YES

MASTER, THIS YEAR WE CAN BUY OR SELL MORE LAND FOR 15 BUSHELS PER ACRE
.
 HOW MANY ACRES DO YOU WISH TO BUY THIS YEAR?
□:
      0
 HOW MANY ACRES DO YOU WISH TO SELL?
□:
      100
HOW MANY BUSHELS OF GRAIN DO YOU WISH TO DISTRIBUTE AS FOOD?
□:
      2000
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
□:
      900
THINK AGAIN, MASTER. YOU HAVE ONLY 873.4 BUSHELS LEFT IN YOUR STORE HO
      USE.
THE GODS DECREE THAT 1 BUSHEL IS REQUIRED TO PLANT 1 ACRE.
PRAY TELL ME AGAIN, MASTER;
HOW MANY ACRES DO YOU WISH TO PLANT WITH SEED?
□:
      873.4

** A YEAR PASSETH...
 LAST YEAR, 4 PEOPLE DIED OF STARVATION,
 AND 1 NEW PEOPLE CAME INTO YOUR DOMAIN.

THE POPULATION OF YOUR DOMAIN IS NOW 96 LOYAL SUBJECTS.

YOU NOW OWN 900 ACRES OF LAND.
WE PLANTED 873.4 ACRES LAST YEAR. WE HARVESTED 5 BUSHELS PER ACRE.
 THE TOTAL HARVEST WAS THEREFORE 4367 BUSHELS.
 YOUR ENEMIES CAUSED RATS TO EAT (YUM) 262.02 BUSHELS.
 THEREFORE, YOU NOW HAVE 4104.98 BUSHELS IN YOUR STOREHOUSE.

MASTER, I AM READY TO EXECUTE YOUR COMMANDS FOR THE FOLLOWING YEAR.
 IF THOU ART READY TO ISSUE THEM, TYPE YES.  IF NOT, TYPE NO.
```

```
YES

MASTER, THIS YEAR WE CAN BUY OR SELL MORE LAND FOR 15 BUSHELS PER ACRE
.
 HOW MANY ACRES DO YOU WISH TO BUY THIS YEAR?
?:
      100
HOW MANY BUSHELS OF GRAIN DO YOU WISH TO DISTRIBUTE AS FOOD?
?:
      20*96
 YOU HAVE ALLOTTED JUST ENOUGH GRAIN FOR YOUR PEOPLE TO SURVIVE.  DO Y
      OU WISH THIS?
YES
TYRANT! ALL THY PEOPLE WILL STARVE! I SHALL LEAD THE REVOLUTION!
FAREWELL!
```

```
      )LOAD ONION
SAVED  16.23.00 03/20/72
      )WIDTH 71
WAS 120
      )FNS
DFT     DIGITS  MIC03   MODELONION      ONIONS  WIDTH
      MODELONION

BASED UPON D.B. SUITS AND S. KOIZUMI,  THE DYNAMICS OF THE ONION
MARKET,  JOURNAL OF FARM ECONOMICS,  VOL. 38, 1956, PP. 475-84.

PT=PRICE PER UNIT IN TIME PERIOD T
QST=QUANTITY SUPPLIED IN TIME PERIOD T
QDT=QUANTITY DEMANDED IN TIME PERIOD T
CT=INDEX OF COST PER UNIT IN TIME PERIOD T
WT=INDEX OF WAGES PAID IN TIME PERIOD T
UT=UNHARVESTED CROP IN TIME PERIOD T
WET=WEATHER INDEX IN TIME PERIOD T
YDT=INDEX OF DISPOSABLE INCOME IN PERIOD T

LOG PT = .681 -2.27×LOG QDT + 1.31×LOG YDT
LOG QST = .134 + .0123×(T-1924) + .324×LOG PT-1 - .512×LOG CT-1
LOG UT = .13 + 2.4×LOG WET + 2.56×LOG QST
EQUILIBRIUM CONDITION:  QST=QDT-UT

NOTE:  EACH SIGN-ON PRODUCES UNIQUE EQUILIBRIUM VALUES VIA RANDOM
NUMBER TRANSFORMS OF FUNCTION PARAMETERS.

      ONIONS
**************************************************************************
THIS PROGRAM ILLUSTRATES THE COBWEB MODEL OF SUPPLY AND DEMAND. IN
THIS MODEL QUANTITY DEMANDED DEPENDS ON CURRENT PRICES, QUANTITY
SUPPLIED DEPENDS ON LAST SEASONS PRICES AND THE MARKET IS CLEARED
EXCEPT FOR RANDOM ERROR THE AMERICAN ONION MARKET IS A TYPICAL
EXAMPLE OF SUCH A MARKET. YOU ARE ASKED TO  ASSUME THE
ROLE OF AN ONION FARMER WHO HAS RESOURCES TO PRODUCE A
MAXIMUM OF FIFTY THOUSAND SACKS OF ONIONS PER YEAR.
ALL OF THE ONIONS YOU HARVEST ARE SOLD, AND YOU WILL
BE WORKING TO FIND THE PRODUCTION LEVEL WHICH MAXIMIZES
YOUR OWN PROFITS. ASSUMING YOU ARE A TYPICAL ONION
FARMER, THIS LEVEL WILL CORRESPOND TO THE POINT
AT WHICH THE SUPPLY AND DEMAND CURVES FOR THE WHOLE MARKET
INTERSECT. HOW MANY SACKS WILL YOU TRY TO PRODUCE IN
THE FIRST YEAR?  (USE A MINUS NUMBER TO QUIT BEFORE THE END.
?:
      3500
 YOU SOLD 3499 SACKS AT  58.93 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 206254.66 DOLLARS.
YOUR OVERALL PROFIT WAS 45401.12844 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      3400
 YOU SOLD 3399 SACKS AT  62.94 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 213988.8 DOLLARS.
YOUR OVERALL PROFIT WAS 45499.60789 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      3350
```

```
 YOU SOLD 3349 SACKS AT  65.09 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 218052.92 DOLLARS.
YOUR OVERALL PROFIT WAS 45522.35315 DOLLARS.
CONGRATULATIONS, YOU HAVE CO E CLOSE TO PROFIT MAXIMIZING
QUANTITY = 3317 SACKS OF ONIONS

**********************************************************************

   BUT UNFORTUNATELY, THE ONION MARKET IS NOT REALLY SO
SIMPLE BECAUSE IT IS AFFECTED BY MANY ENVIRONMENTAL AND
ECHONOMIC CONDITIONS. FOR AN EXAMPLE, WE WILL LET NATIONAL
DISPOSABLE INCOME INCREASE, WHICH WILL CAUSE A SHIFT IN
THE ONION MARKETS DEMAND CURVE. DECIDE WHAT EFFECT
THIS WILL HAVE ON THE LEVEL OF PRODUCTION NECESSARY TO
MAXIMIZE YOUR OWN PROFITS, AND CONTINUE.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      4000
 YOU SOLD 3999 SACKS AT  55.26 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 221047.84 DOLLARS.
YOUR OVERALL PROFIT WAS 53643.22695 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      3400
 YOU SOLD 3399 SACKS AT  79.91 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 271718.04 DOLLARS.
YOUR OVERALL PROFIT WAS 54603.0164 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      3500
 YOU SOLD 3499 SACKS AT  74.83 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 261897.41 DOLLARS.
YOUR OVERALL PROFIT WAS 54621.68929 DOLLARS.
CONGRATULATIONS, YOU HAVE COME CLOSE TO PROFIT MAXIMIZING
QUANTITY = 3469 SACKS OF ONIONS

**********************************************************************

A WAGE INCREASE IS NECESSARY FOR YOUR WORKERS DURING
THE NEXT SEASON, AND THIS WILL SHIFT YOUR SUPPLY CURVE.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      4000
 YOU SOLD 3999 SACKS AT  55.26 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 221047.84 DOLLARS.
YOUR OVERALL PROFIT WAS 47737.89159 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      3800
 YOU SOLD 3799 SACKS AT  62.08 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 235925.74 DOLLARS.
YOUR OVERALL PROFIT WAS 47793.49335 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?:
      3850
```

```
 YOU SOLD 3849 SACKS AT  60.27 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 232041.6 DOLLARS.
YOUR OVERALL PROFIT WAS 47803.07873 DOLLARS.
CONGRATULATIONS, YOU HAVE COME CLOSE TO PROFIT MAXIMIZING
QUANTITY = 3853 SACKS OF ONIONS

**********************************************************************

THE COST OF ONION SEEDS HAS JUST GONE DOWN ENABLING
YOU TO PRODUCE MORE AT A LOWER COST.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?
      4500
 YOU SOLD 4499 SACKS AT  42.29 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 190338.99 DOLLARS.
YOUR OVERALL PROFIT WAS 44505.4461 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?
      3900
 YOU SOLD 3899 SACKS AT  58.53 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 228270.31 DOLLARS.
YOUR OVERALL PROFIT WAS 44918.03461 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?
      4050
 YOU SOLD 4049 SACKS AT  53.72 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 217588.08 DOLLARS.
YOUR OVERALL PROFIT WAS 44979.04378 DOLLARS.
CONGRATULATIONS, YOU HAVE COME CLOSE TO PROFIT MAXIMIZING
QUANTITY = 4042 SACKS OF ONIONS

**********************************************************************

POOR WEATHER IS PREDICTED FOR THE COMING SEASONS, AND
THIS WILL REDUCE YOUR HARVEST SIGNIFICANTLY.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?
      4500
 YOU SOLD 4332 SACKS AT  46.1 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 199737.42 DOLLARS.
YOUR OVERALL PROFIT WAS 44774.40952 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?
      4300
 YOU SOLD 4150 SACKS AT  50.81 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 210898.51 DOLLARS.
YOUR OVERALL PROFIT WAS 44948.2024 DOLLARS.
HOW MANY SACKS WILL YOU TRY TO PRODUCE NEXT YEAR.
?
      4200
 YOU SOLD 4059 SACKS AT  53.44 DOLLARS
PER SACK. YOUR TOTAL REVENUE WAS 216938.61 DOLLARS.
YOUR OVERALL PROFIT WAS 44978.41019 DOLLARS.
CONGRATULATIONS, YOU HAVE COME CLOSE TO PROFIT MAXIMIZING
QUANTITY = 4042 SACKS OF ONIONS

**********************************************************************

YOU HAVE RECEIVED RECOGNITION AS AN OUTSTANDING ONION
FARMER. THIS IS THE END OF THIS PROGRAM.
```

```
      )LOAD PRESENTVALUE
SAVED  16.57.03 04/21/72

      )FNS
ANNUITY DFT     DPRESENTVALUE   HYP     INTEREST        PRESENTVALUE
REPAY   SAVE    SIZE    SQRT
      DPRESENTVALUE


    THIS PROGRAM CALCULATES PRESENT VALUES, FUTURE VALUES,
AND DISCOUNT RATES, USING DISCRETE OR CONTINUOUS COMPOUNDING.
THE CALCULATIONS ARE BASED ON THE FORMULAS:

          F=P×ε*(Y×R)          CONTINUOUS COMPOUNDING
          F=P×(1+R÷T)*(Y×T)    DISCRETE COMPOUNDING
WHERE
          P=PRESENT VALUE
          F=FUTURE VALUE
          Y=NUMBER OF YEARS (PERIODS) COMPOUNDED
          R=INTEREST RATE PER YEAR (PERIOD)
          T=NUMBER OF COMPOUNDINGS PER YEAR (PERIOD).

IN USING THE PROGRAM, ALL PARAMETERS, INCLUDING THE ONE
UNKNOWN, ARE ENTERED, AND THE UNKNOWN IS SOLVED FOR.  WHEN
THE UNKNOWN QUANTITY IS REQUESTED, TYPE→   FIND    .AN EXAMPLE
OF THIS IS:
          P=24,R=.05,T=4,Y=300,F=FIND

WHEN ALL QUANTITIES EXCEPT THE FUTURE VALUE ARE ASKED FOR,
ENTER THE QUANTITY BY TYPING   24   .05  4  ETC.
WHEN THE PROGRAM ASKS 'ENTER FUTURE VALUE', TYPE→ FIND
THE PROGRAM WILL THEN SOLVE FOR THE FUTURE VALUE AND
PRINT ALL THE VALUES INVOLVED.

TO USE THE PROGRAM TYPE→  PRESENTVALUE

      PRESENTVALUE
ENTER PRESENT VALUE
□:
      FIND
ENTER FUTURE VALUE
□:
      1000
ENTER INTEREST RATE
□:
      .08
CONTINUOUS OR DISCRETE COMPOUNDING?
□:
      DISCRETE
ENTER NUMBER OF COMPOUNDINGS PER YEAR (PERIOD)
□:
      4
ENTER NUMBER OF YEARS (PERIODS)
□:
      10
```

```
************************************
PRESENT VALUE    =452.8904152

FUTURE VALUE     =1000

INTEREST RATE    =0.08

COMPOUNDED 4 TIMES A YEAR (PERIOD)

COMPOUNDED 10 YEARS (PERIODS)
************************************

      PRESEB
           v
           NTVALUE
ENTER PRESENT VALUE
□:
      500
ENTER FUTURE VALUE
□:
      1000
ENTER INTEREST RATE
□:
      FIND
CONTINUOUS OR DISCRETE COMPOUNDING?
□:
      DISCRETE
ENTER NUMBER OF COMPOUNDINGS PER YEAR (PERIOD)
□:
      4
ENTER NUMBER OF YEARS (PERIODS)
□:
      10

************************************
PRESENT VALUE    =500

FUTURE VALUE     =1000

INTEREST RATE    =0.06991876841

COMPOUNDED 4 TIMES A YEAR (PERIOD)

COMPOUNDED 10 YEARS (PERIODS)
************************************

      ANNUITY

ENTER THE AMOUNT OF THE ANNUITY
□:
      100
ENTER THE NUMBER OF YEARS OVER WHICH THE ANNUITY WILL BE RECEIVED
□:
      20
ENTER THE APPROPRIATE DISCOUNT RATE
□:
      .08
```

```
- - - - - - -

YEAR    AMOUNT

1       92.59259259
2       85.73388203
3       79.3832241
4       73.50298528
5       68.0583197
6       63.01696269
7       58.34903953
8       54.02688845
9       50.02489671
10       46.31934881
11       42.88828593
12       39.71137586
13       36.76979247
14       34.04610414
15       31.5241705
16       29.18904676
17       27.02689514
18       25.02490291
19       23.1712064
20       21.45482074

THE PRESENT VALUE OF THE ANNUITY STREAM IS 981.8147407 DOLLARS

      SIZE

ENTER PRINCIPAL TO BE BORROWED
?:
      30000

ENTER ANNUAL INTEREST RATE
?:
      .075

ENTER THE NUMBER OF YEARS OVER
WHICH MONTHLY INSTALLMENTS ARE
TO BE PAID
?:
      30

YOUR MONTHLY PAYMENT WILL BE APPROXIMATELY:  209.7643526 DOLLARS

IF YOU WISH, YOU MAY CHECK THIS VALUE
BY USING THE PROGRAM REPAY.

END

      REPAY

ENTER PRINCIPAL TO BE BORROWED
?:
      30000

ENTER ANNUAL INTEREST RATE
?:
      .075

ENTER APPROXIMATE MONTHLY
PAYMENT FROM PROGRAM SIZE
?:
```

```
      209.76

YOU WILL HAVE A TOTAL OF 361 PAYMENTS

OF WHICH 360 ARE 209.76 DOLLARS,

AND THE LAST PAYMENT IS 6.24

YOUR PAYMENTS WILL SUM TO 75519.84 DOLLARS.

IF YOU WISH YOU MAY EXECUTE THIS
PROGRAM AGAIN WITH A SLIGHTLY
LARGER OR SMALLER PAYMENT.

END

      INTEREST

ENTER PRINCIPAL
?:
      100.00

ENTER NUMBER OF YEARS
?:
      10

ENTER RATES OF INTEREST UNDER CONSIDERATION,
E.G., .05   .06   .07
?:
      .05   .075   .10

   0              0.05            0.075             0.1
   1              105             107.5             110
   2              110.25          115.5625          121
   3              115.7625        124.2296875       133.1
   4              121.550625      133.5469141       146.41
   5              127.6281562     143.5629326       161.051
   6              134.0095641     154.3301526       177.1561
   7              140.7100423     165.904914        194.87171
   8              147.7455444     178.3477826       214.358881
   9              155.1328216     191.7238662       235.7947691
  10              162.8894627     206.1031562       259.374246
```

```
      )LOAD MAXIMIZE
SAVED  16.21.17 03/20/72
      )WIDTH 71
WAS 120
      )FNS
DFT     MICAS   MICBS   PLOT    PRESENTVALUE    PROFIT
      PROFIT

**********PROFIT**********

PROFIT  ILLUSTRATES THE RELATIONSHIP BETWEEN PROFIT MAX-
IMIZING PRICE, MARGINAL REVENUE AND PRICE ELASTICITY OF
DEMAND.

MARGINAL REVENUE (MR) IS DEFINED AS THE ADDITION TO TOTAL
REVENUE (TR) ATTRIBUTABLE TO THE ADDITION OF ONE UNIT OF
 OUTPUT TO SALES.  THE FOLLOWING TABLE SHOWS QUANITY
 DEMANDED (Q) AND TOTAL REVENUE (TR=P×Q) FOR A PRODUCT
 A DIFFERENT PRICES (P)
      P     Q    TR
   4.00   291  1164
   3.80   315  1197
   3.60   344  1238
   3.40   376  1278
   3.20   415  1328
   3.00   459  1377
   2.80   513  1436
   2.60   577  1500
   2.40   655  1572
   2.20   752  1654
   2.00   875  1750
   1.80  1034  1861
   1.60  1247  1995
   1.40  1542  2159
 WHAT IS MR  WHEN P = 3.4
 □:
      40÷32
 RIGHT!  THE MR =1.25
 WHAT IS MR  WHEN P = 3.2
 □:
      1.27
```

RIGHT! THE MR =1.271794872

THE NEXT TABLE SHOWS TOTAL COST (TC), ASSUMING A LINEAR COST FUNCTION, AND NET PROFIT (NP), IN ADDITION TO Q AND TR FOR EACH PRICE LEVEL.

P	Q	TR	TC	NP
4.00	291	1164	389	775
3.80	315	1197	417	780
3.60	344	1238	451	787
3.40	376	1278	488	790
3.20	415	1328	534	794
3.00	459	1377	585	792
2.80	513	1436	648	788
2.60	577	1500	723	777
2.40	655	1572	814	758
2.20	752	1654	927	728
2.00	875	1750	1070	680
1.80	1034	1861	1256	606
1.60	1247	1995	1504	491
1.40	1542	2159	1848	311

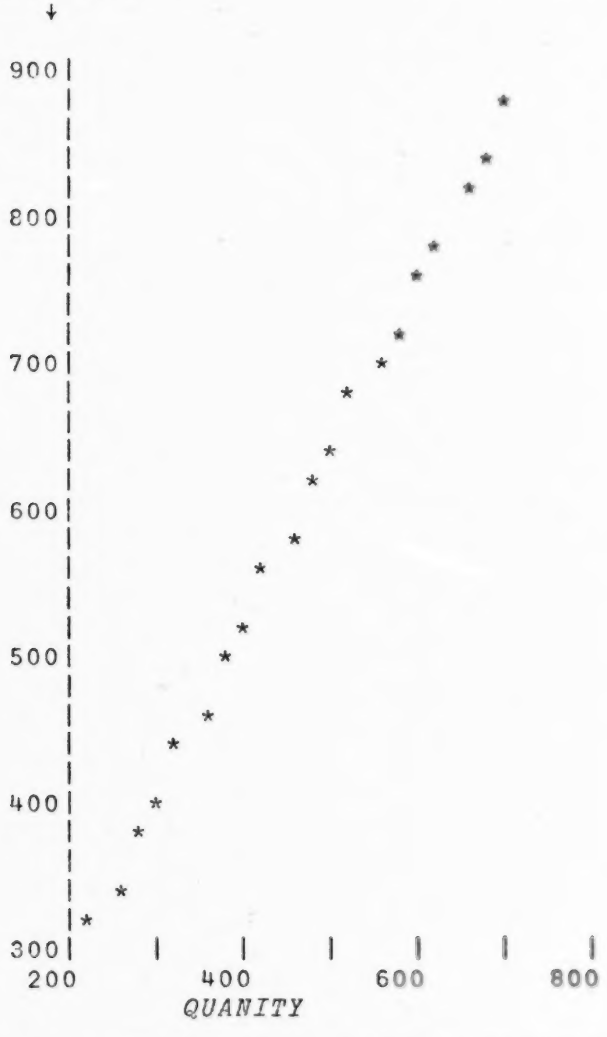
MARGINAL COST (MC) IS DEFINED IN THE SAME WAY THAT MARGINAL REVENUE WAS DEFINED, EXCEPT THAT TOTAL COST IS USED INSTEAD OF TOTAL REVENUE.

WHAT IS MC WHEN P = 3.6 ?
?:
(451-417)÷(344-315)
CORRECT. THE MC IS 1.166
WHAT IS MC WHEN P = 3.2 ?
?:
1.2

CORRECT. THE MC IS 1.166
NOTICE THAT MC IS APPROXIMATELY THE SAME AT ALL PRICE LEVELS. THE REASON IS THAT A LINEAR COST FUNCTION HAS BEEN USED IN CONSTRUCTING THIS EXAMPLE:

TC = FIXED COST + (VARIABLE COST PER UNIT)*Q

THE GRAPH OF A LINEAR COST FUNCTION LOOKS LIKE THIS:



WHENEVER A LINEAR COST FUNCTION IS USED, MC= VARIABLE COST PER UNIT. HERE MC = 1.166
WHAT IS MR WHEN NET PROFIT IS MAXIMUM ?
?:
2.0
SORRY. PROFITS ARE MAXIMIZED WHEN P = 3.1
TRY AGAIN.
?:
3.2

ETC.

OLIGOP

GAME IN THE LOGISTICS OF AN OLIGOPOLY MARKET

GENERAL INSTRUCTIONS

OBJECTIVE

YOUR TEAM HAS TAKEN OVER THE MANAGEMENT OF ONE OF A SMALL NUMBER OF IDENTICAL FIRMS IN AN INDUSTRY. YOU ARE GIVEN INFORMATION ON YOUR COSTS BELOW. THE DEMAND FOR YOUR OUTPUT DEPENDS ON YOUR PRICE, YOUR COMPETITORS' PRICES, AND ON FORCES BEYOND YOUR CONTROL.

YOU ARE A RESPONSIBLE MANAGEMENT TEAM AIMING TO MAXIMIZE THE WELFARE OF YOUR STOCKHOLDERS. ALL PROFITS ARE CONSIDERED TO BE PAID OUT IN DIVIDENDS, SO MAXIMIZING THE PRESENT VALUE OF PROFITS MAY BE A REASONABLE OBJECTIVE. RATINGS ARE BASED UPON PROFITS.

CONSTRAINTS

ALL FIRMS HAVE FIXED COSTS (INTEREST PAYMENTS ON LONG-TERM DEBT, YOUR SALARIES, ETC.) OF 50,000.00 PER PERIOD. VARIABLE COSTS (LABOR AND MATERIALS) ARE CONSISTENT AT 50 CENTS PER UNIT UP TO CAPACITY. CAPACITY IS 100,000 UNITS PER PERIOD FOR ALL FIRMS. UNFILLED ORDERS CAUSE AN INCREASE IN COMPETITORS' DEMAND.

LEGAL SITUATION

THERE ARE THREE POSSIBLE LEGAL ENVIRONMENTS:

I. THE INDUSTRY IS BOUND BY THE SHERMAN ACT.
II. ALL FIRMS AGREE TO AN ENFORCEABLE CARTEL ARRANGEMENT.
III. CARTELS ARE NOT ILLEGAL, BUT THERE IS NO WAY TO LEGALLY ENFORCE THEM.

MECHANICS

AN IMPARTIAL GAME ADMINISTRATOR WILL INITIALIZE THE GAME PARAMETERS, AND RENDER IDENTICAL DECISIONS FOR ALL FIRMS FOR THE FIRST PERIOD. ONCE YOU RECEIVE THE INITIAL PRINTOUT AND FAMILIARIZE YOURSELF WITH THE INFORMATION, THE GAME MAY PROCEED FOR AS MANY QUARTERS AS YOU WISH TO PLAY. THERE IS NO DATA STORAGE -- THE GAME MUST BE PLAYED SEQUENTIALLY.

TO PLAY THE GAME TYPE→ OLIGOPOLY

```
    OLIGOPOLY
 YOU HAVE JUST ENTERED INTO THE DOMAIN OF THE OLIGOPOLY GAME !
 TYPE THE NUMBER OF FIRMS COMPETING IN THIS GAME.
? :
      3
 ENTER A BRIEF INDUSTRY DESCRIPTION.
OIL ADDITIVE
 DO YOU WISH TO HAVE STUDENT OUTPUT ?
YES
 PLEASE ENTER MONOPOLY PRICE
? :
      7.29
 ENTER VALUE FOR A-FACTOR
? :
      4.0

ENTER YOUR FIRM'S PRICE
 STUDENT FROM FIRM NUMBER 1 ENTER YOUR PRICE
 :
      5.25


 STUDENT FROM FIRM NUMBER 2 ENTER YOUR PRICE
? :
      8.59


 STUDENT FROM FIRM NUMBER 3 ENTER YOUR PRICE
? :
      7.49
```

INSTRUCTOR'S OUTPUT

INDUSTRY DESCRIPTION :OIL ADDITIVE
PERIOD NUMBER 1
MONOPOLY PRICE 7.29 CHEATERS PRICE 6.508069725
STANDARD DEVIATION OF DEMAND 4305.810398

PRICES	5.25	8.59	7.49
SALES	100000.00	0.00	0.00
UNFILLED ORDERS	134471.36	0.00	0.00
PROFITS	425000.00	-50000.00	-50000.00
RATING	133.63	-16.19	-16.46

TO CALCULATE RATINGS BASED ON NON-RANDOM PROFITS
RUN PROGRAM AGAIN SETTING A-FACTOR TO ZERO.

INDUSTRY SALES	100000
INDUSTRY PROFITS	325000
AVERAGE PRICE	7.11
INDUSTRY RATING	34.9167005

STUDENT OUTPUT

FIRM NUMBER	1
PRICE	5.25
SALES	100000.00
UNFILLED ORDERS	134471
PROFITS	425000.00
RATING	133.63
INDUSTRY SALES	100000.00
AVERAGE PRICE	7.11

FIRM NUMBER	2
PRICE	8.59
SALES	0.00
UNFILLED ORDERS	0
PROFITS	-50000.00
RATING	-16.19
INDUSTRY SALES	100000.00
AVERAGE PRICE	7.11

FIRM NUMBER	3
PRICE	7.49
SALES	0.00
UNFILLED ORDERS	0
PROFITS	-50000.00
RATING	-16.46
INDUSTRY SALES	100000.00
AVERAGE PRICE	7.11

STUDENT EVALUATION

A total of 183 students enrolled in day economics courses during the Spring 1972 semester experienced some form of computer assisted instruction (CAI). Of this number 98 used the APL computer terminal for one or more mandatory, optional, or remedial assignments. Obviously, one terminal available five or fewer hours per day cannot service a large student population. The following student questionnaire was prepared to assess the impact of CAI generally, and for those students who had experienced both "batch" and interactive terminal CAI, the relative impact of batch processing versus terminal processing.

% Responding*			Response item
yes	no	no opinion	
73%	13%	13%	The use of the computer allowed me to understand economic concepts as well as or better than a textbook.
92	6	3	The use of the computer created more interest in the material covered than would have existed without it.
2	12	87	The prepared computer assignments were a bother and a waste of my time.
7	30	62	Most students paid little attention to the computer exercises, games, and simulations.
83	10	6	I would like to see the college expand its computer services for instructional purposes.

* *

Answer these questions only if you had experience with both the "batch" games and the APL computer terminal.

39%	28%	33%	I prefer the batch processing to the terminal processing.
58	26	14	To me, the immediate feedback of the terminal system was preferable to waiting for the results from the batch method.
21	15	64	The terminals were too fast since I felt pressured to give a reply before I had time to think about it.
75	15	9	The computer terminal alowed me to explore realities or solve problems that would have been very difficult or impossible to accomplish by other means.
5	29	65	It is unnecessary to have computer terminals in order to receive the full benefit of computerized learning experiences.

*May not add to 100% due to rounding.

INSTRUCTOR'S OUTPUT

INDUSTRY DESCRIPTION :OIL ADDITIVE
PERIOD NUMBER 1
MONOPOLY PRICE 7.29 CHEATERS PRICE 6.568069725
STANDARD DEVIATION OF DEMAND 4305.810398

PRICES	5.25	8.59	7.49
SALES	100000.00	0.00	0.00
UNFILLED ORDERS	134471.30	0.00	0.00
PROFITS	425000.00	-50000.00	-50000.00
RATING	133.63	-16.19	-16.46

TO CALCULATE RATINGS BASED ON NON-RANDOM PROFITS
RUN PROGRAM AGAIN SETTING A-FACTOR TO ZERO.

INDUSTRY SALES	100000
INDUSTRY PROFITS	325000
AVERAGE PRICE	7.11
INDUSTRY RATING	34.9167005

STUDENT OUTPUT

FIRM NUMBER	1
PRICE	5.25
SALES	100000.00
UNFILLED ORDERS	134471
PROFITS	425000.00
RATING	133.63
INDUSTRY SALES	100000.00
AVERAGE PRICE	7.11

FIRM NUMBER	2
PRICE	8.59
SALES	0.00
UNFILLED ORDERS	0
PROFITS	-50000.00
RATING	-16.19
INDUSTRY SALES	100000.00
AVERAGE PRICE	7.11

FIRM NUMBER	3
PRICE	7.49
SALES	0.00
UNFILLED ORDERS	0
PROFITS	-50000.00
RATING	-16.46
INDUSTRY SALES	100000.00
AVERAGE PRICE	7.11

STUDENT EVALUATION

A total of 183 students enrolled in day economics courses during the Spring 1972 semester experienced some form of computer assisted instruction (CAI). Of this number 98 used the APL computer terminal for one or more mandatory, optional, or remedial assignments. Obviously, one terminal available five or fewer hours per day cannot service a large student population. The following student questionnaire was prepared to assess the impact of CAI generally, and for those students who had experienced both "batch" and interactive terminal CAI, the relative impact of batch processing versus terminal processing.

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5	29	65	It is unnecessary to have computer terminals in order to receive the full benefit of computerized learning experiences.

*May not add to 100% due to rounding.